

Reactor Institute Delft (RID)

Patricia Bekhuis
Frans Wiersma



Reactor Institute Delft (RID)

**innovative research on nuclear expertise
relevance of radiation, radionuclides and reactors,
with special focus on health, energy and materials**

Employees:	180
PhD students and postgraduates	70
Students	300
Graduating per year	45
Scientific publications per year:	140
Students Radiation Protection per year:	800



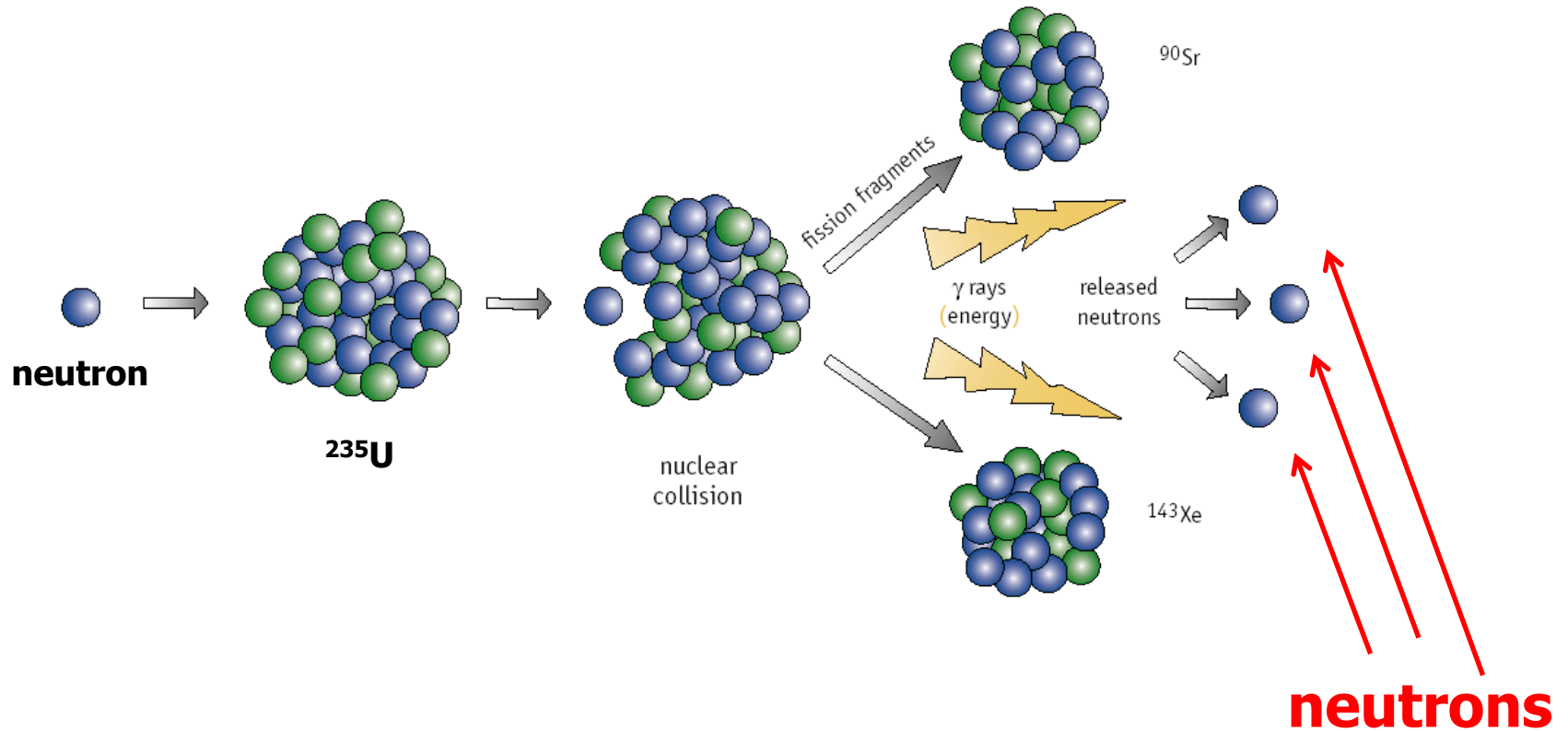
IAEA Collaborating Centre



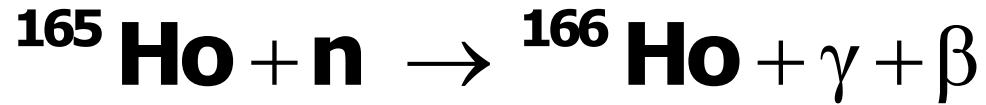
- one of the 4 in Europe

**- one of the 13 world wide
(of a total of ~280 research reactors)**

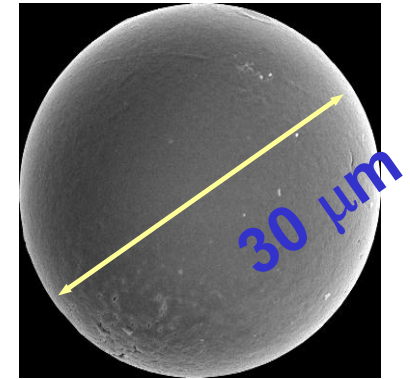
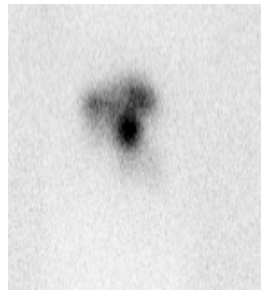
Nuclear fission



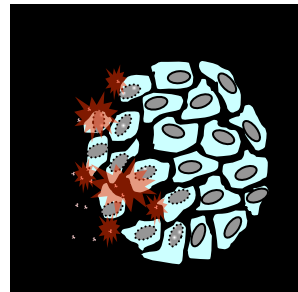
Holmium micro-sphere



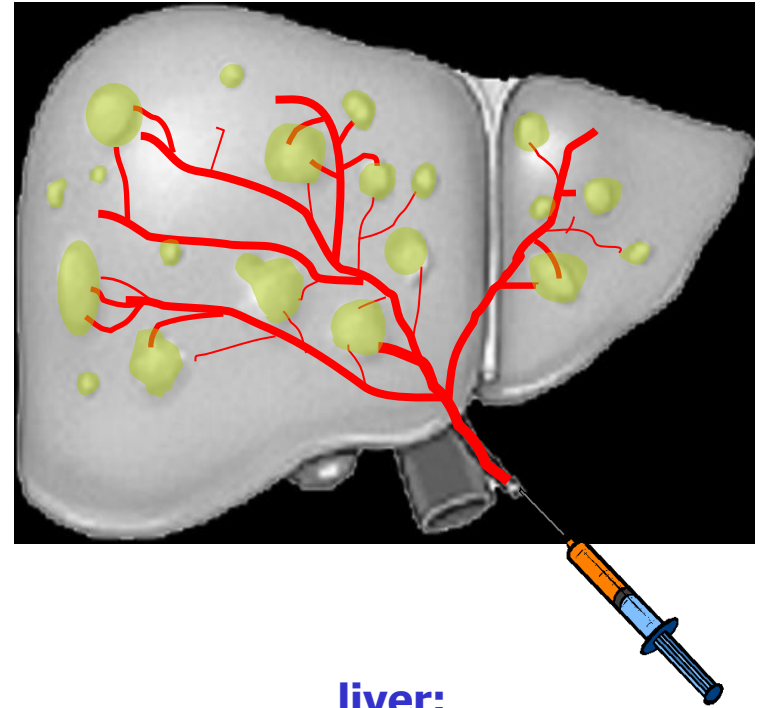
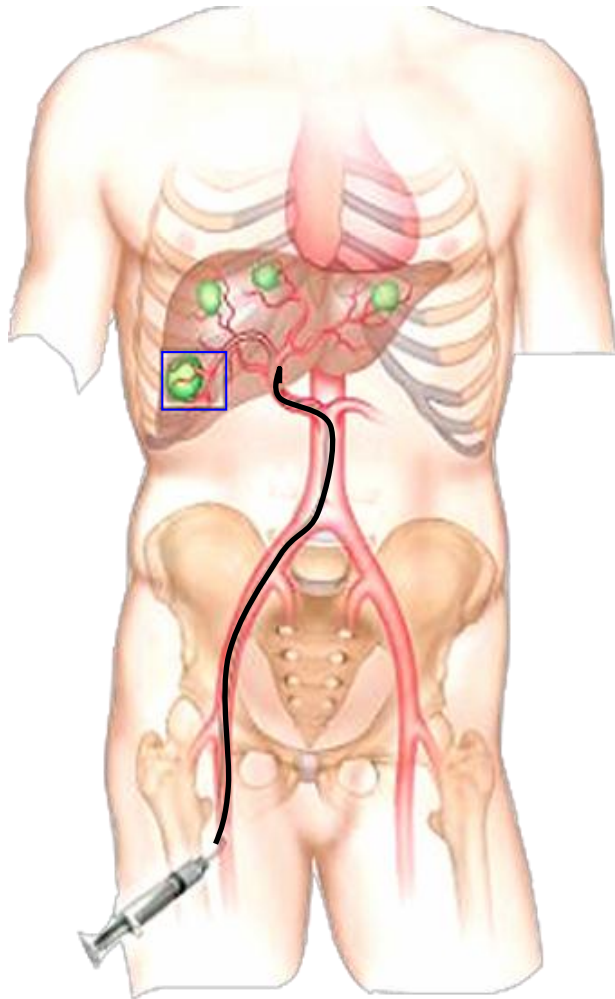
energy of γ : 81 keV
(image)



energy of β : 1,84 MeV
(therapy)



Treatment procedure



liver:

- 70% portal vein
- 30% **artery**

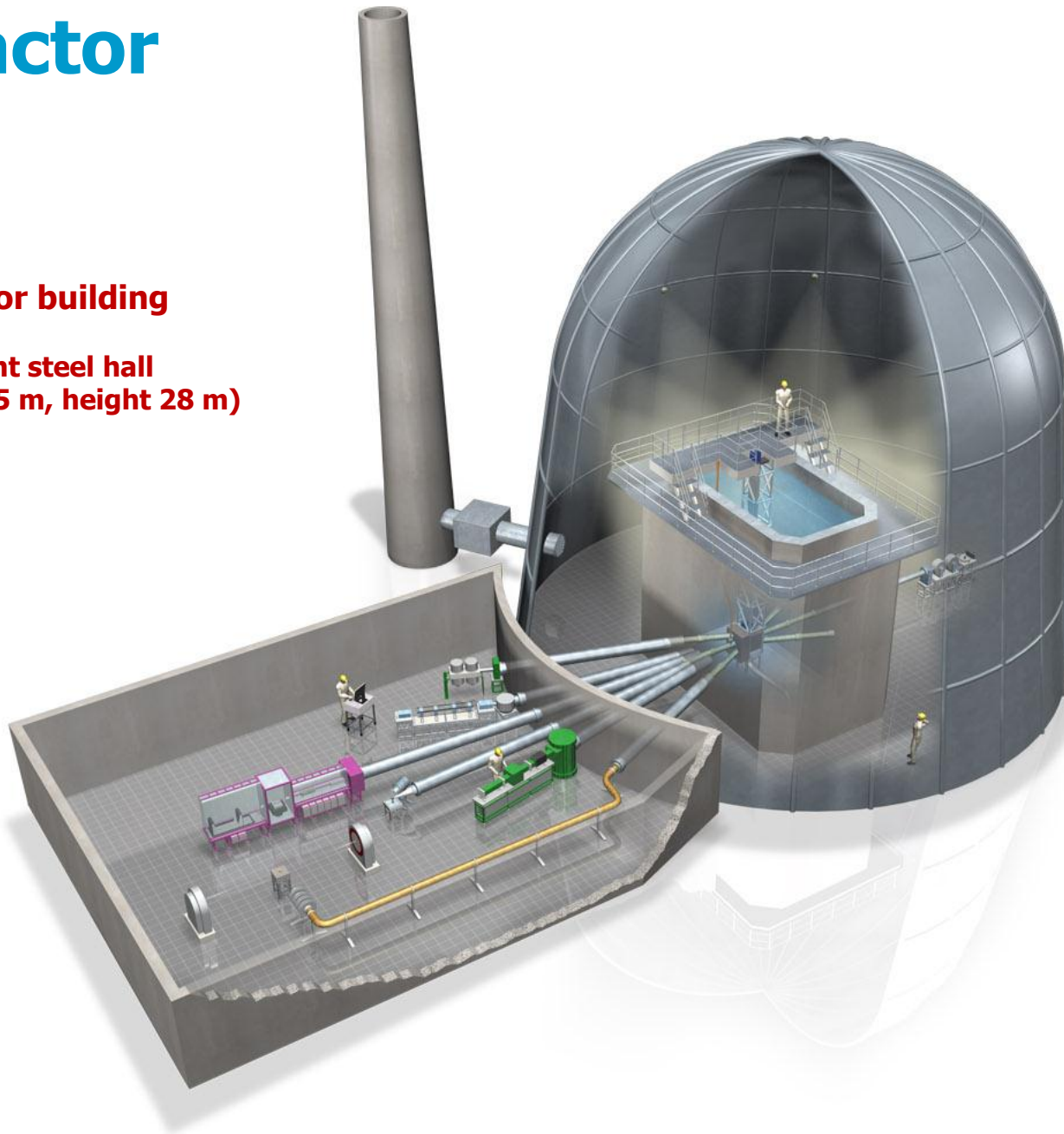
tumor:

- 99% **artery**

Reactor

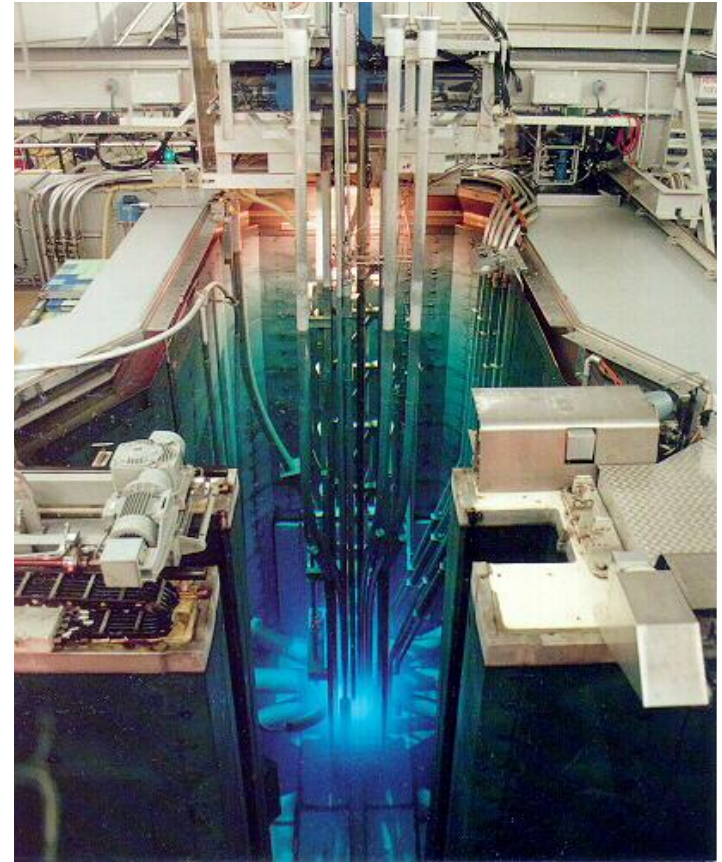
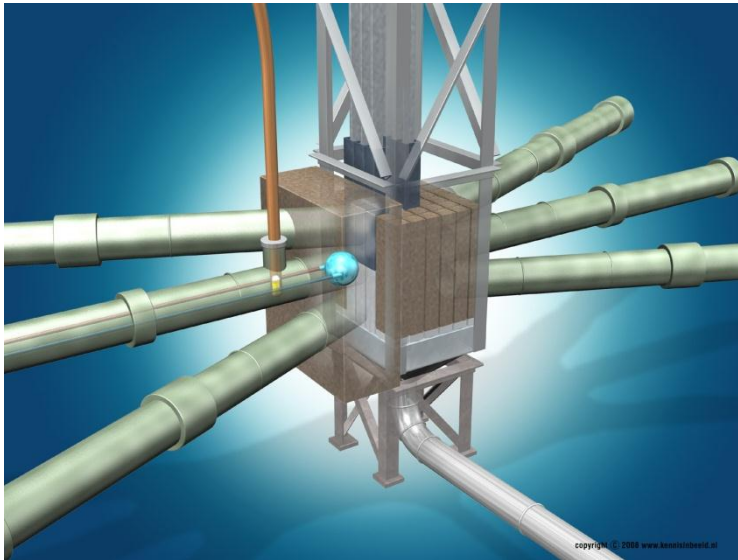
Reactor building

airtight steel hall
(diameter 25 m, height 28 m)



Reactor core

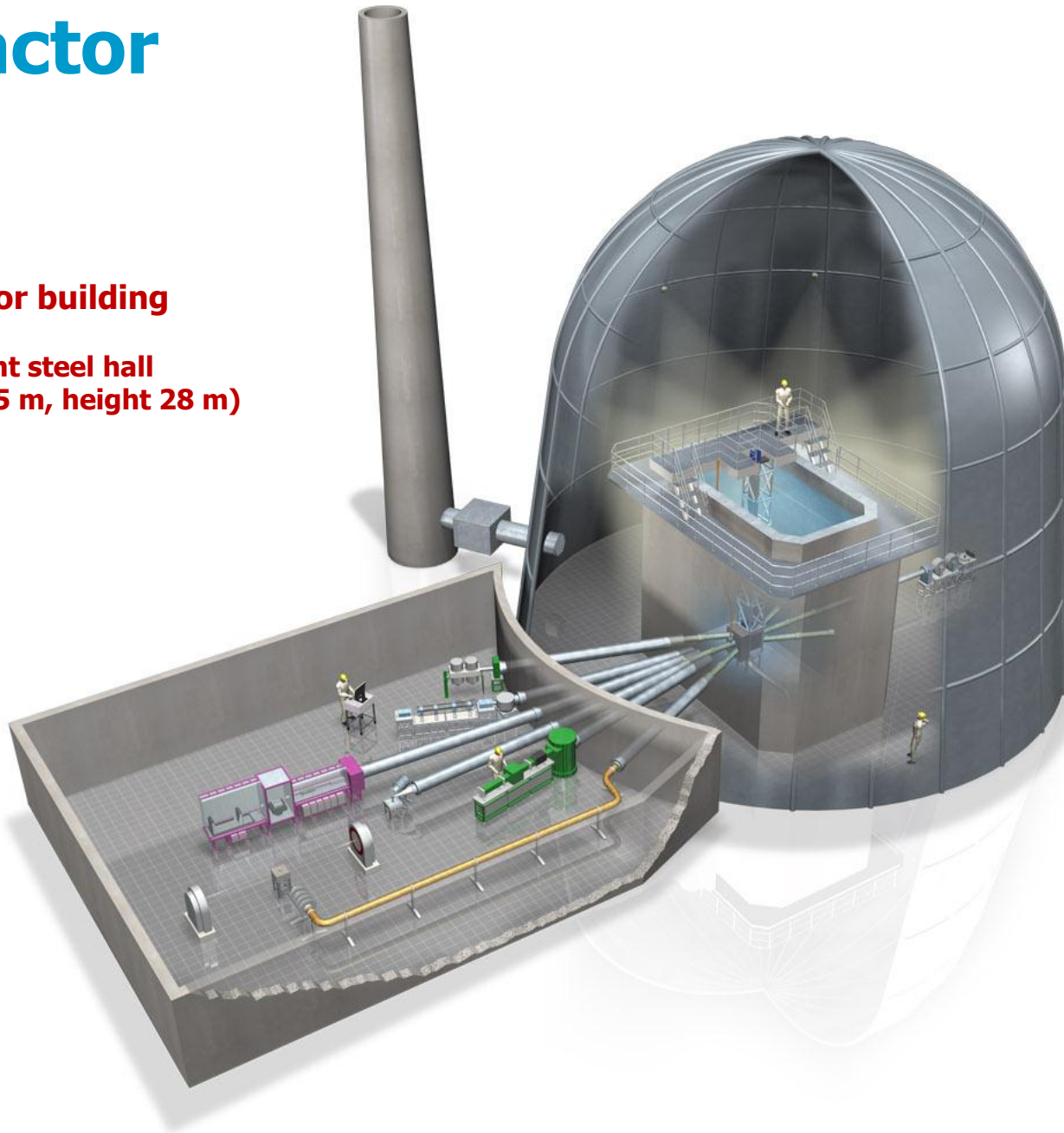
neutrons in beam guides



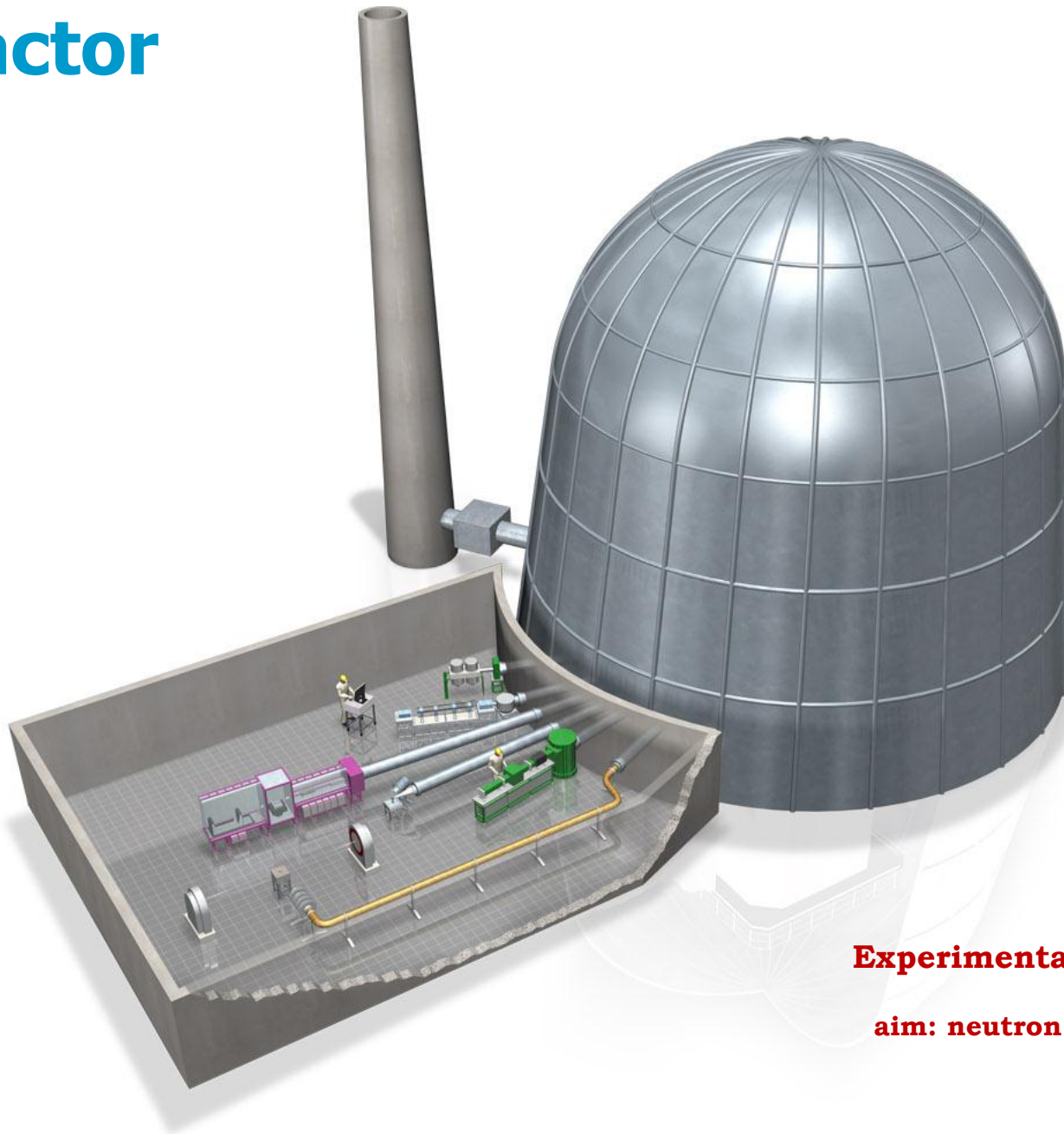
Reactor

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Reactor



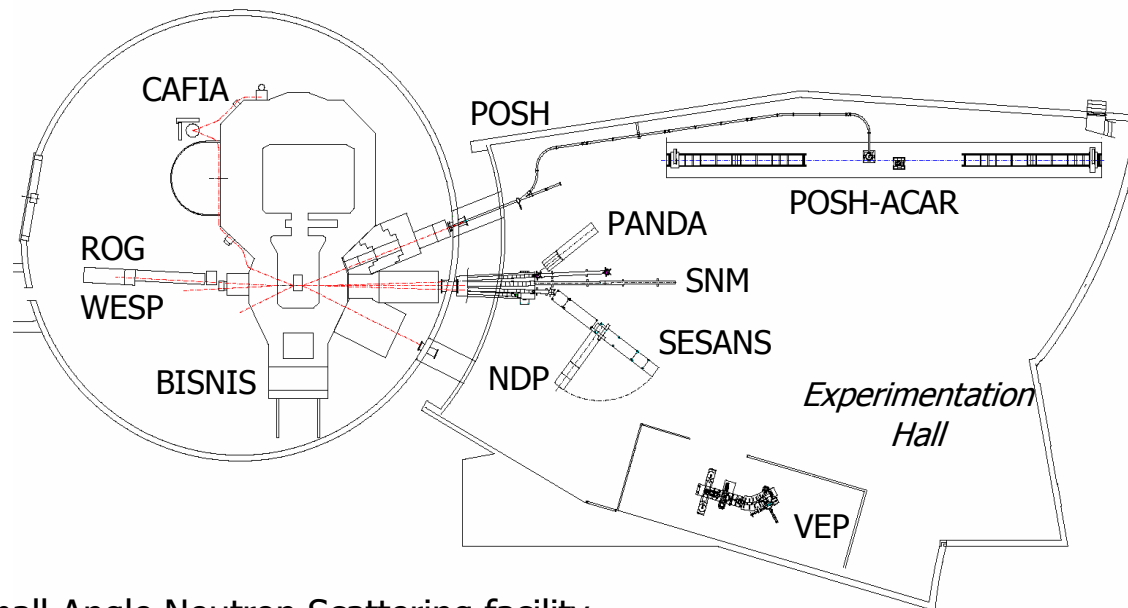
Experimentation Hall

aim: neutron research

Experimentation Hall

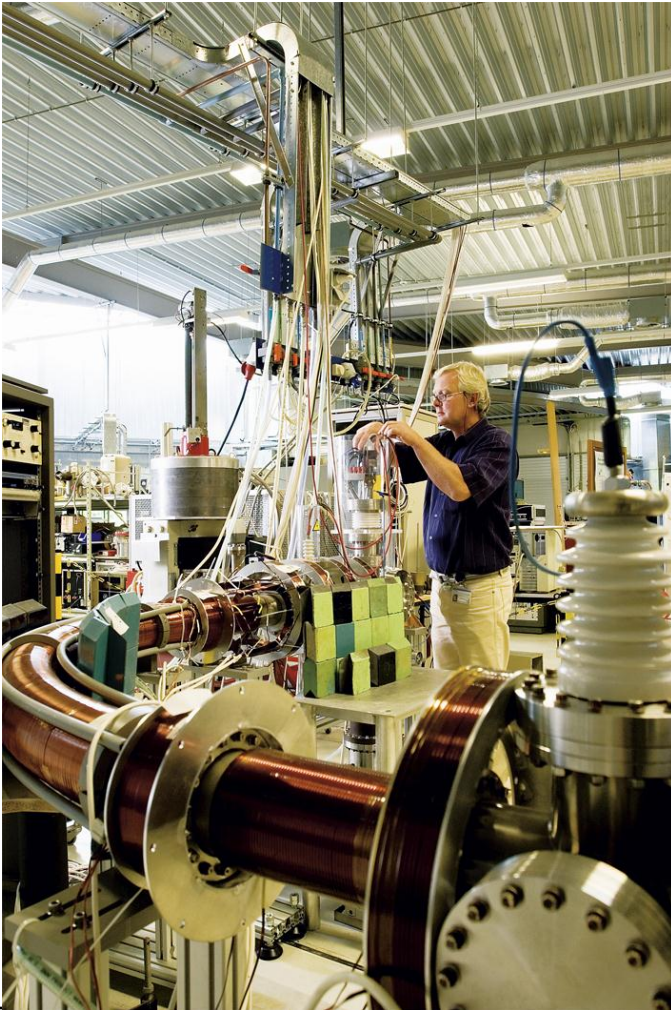
POSH: POSitrons at the Higher Education reactor 2-Detector Angular Correlation Annihilation Radiation

PANDA: Poly Axis Neutron Depolarization Analysis



SESANS: Spin Echo Small Angle Neutron Scattering facility

Experimentation Hall



Radiation Protection courses

Description of the education system

In the Netherlands there are 4 different levels in the education and training in radiation protection. The lowest level is 5, the highest is 2.



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level 5 is about radiation protection with low risk sources



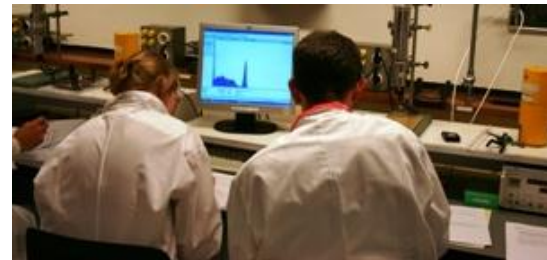
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level 4 is about radiation protection with medium risk sources



Radiation Protection courses

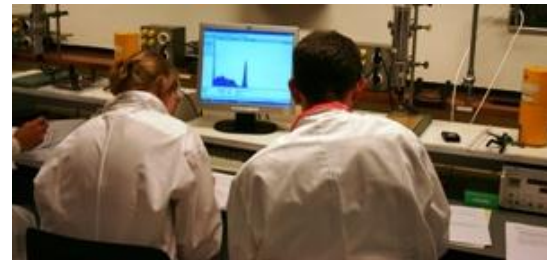
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level 1: in progress...



Overview

RW: Radiation Worker
RPO: Radiation Protection Officer
RPE: Radiation Protection Expert

Type	RPE	RPO	RW
NPP, research reactors	2	3	4 and 5
waste management	2	3	4 and 5
non-nuclear research	3	3	4 and 5
medical	2	3	4 and 5
NORM	3	5B	5B
industrial (e.g. NDT)	3	4 and 5	5

Radiation Protection courses

Special courses

Nuclear Technology (visiting nuclear plants)

Introduction course ^{166}Ho

Radiation Protection for Biomedical Sciences

Instruction Radio Diagnostic Workers

Safety training URENCO Enrichment Facilities

Coaching in Ionizing Radiation for Medical Staff

In service training for employees of PWR (Borssele)



Training institute

Delft / **Utrecht** – RID

**National Centre of
Radiation Protection**

<http://www.rid.tudelft.nl/opleidingen-stralingsveiligheid>



RID in Northwest Europe



Two research complexes host the world's top scientists in the field of neutron research:

ISIS, Oxford, England
large pulsed neutron source

ILL, Grenoble, France
powerful research reactor

RID in Northwest Europe



ISIS commissions instruments from the **RID**.

ILL makes use of **RID** knowledge and ideas.

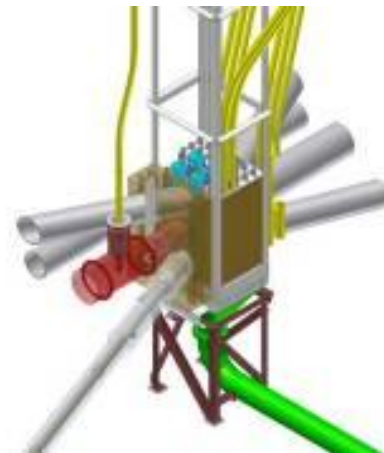
At the **RID** fundamental and experimental research is conducted that would not be suitable for ISIS and ILL.

OYSTER

Optimised **Y**ield - for **S**cience, **T**echnology and **E**ducation - of **R**adiation



- cold neutron source
- highest density fuel
- 50% higher power



OYSTER, outcome

Effective increase in n-beam facility performance:

ROG: 100 times better spatial resolution (to 0.1 nm)

PANDA: 20 times better resolution

SESANS: 100 times higher count rate, time resolution from 10 min to 1 s

Increase in thermal neutron fluence rate in irradiation facilities:

PIF: 10 times higher thermal neutron fluence rate ($\sim 6 \times 10^{13} \text{ s}^{-1} \text{ cm}^{-2}$)

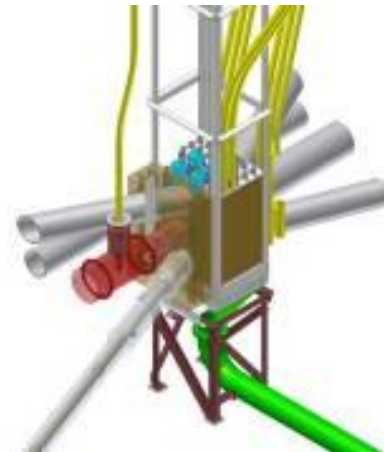
BISNIS: 30 times higher thermal neutron fluence rate ($\sim 10^{10} \text{ s}^{-1} \text{ cm}^{-2}$)

CAFIA: 2 times higher thermal neutron fluence rate ($\sim 7 \times 10^{12} \text{ s}^{-1} \text{ cm}^{-2}$)

Increase in positron fluence rate:

POSH: 7 times higher positron output ($\sim 1.5 \times 10^9 \text{ s}^{-1}$)

2D-ACAR: 60 times gain improvement



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4 new innovative instruments

CNIF (cold neutron irradiation facility): activation and isotope production
SNM (scanning neutron microscopy): spatially resolved, quantitative element imaging and PGAA
PALS (positron annihilation lifetime spectroscopy): studies of imperfections in materials
NDF (neutron diffraction facility): studies of H and Li + magnetic structures

